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# A study of the effects of base in and base out prism to phorias at three distances and the effects of plus and minus lens power to cross cylinder findings at the afore mentioned distances

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## Abstract

A study of the effects of base in and base out prism to phorias at three distances and the effects of plus and minus lens power to cross cylinder findings at the afore mentioned distances



## Degree Type

Thesis

## Degree Name

Master of Science in Vision Science

## Committee Chair

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Optometry

# A STUDY OF THE EFFECTS OF BASE IN AND BASE OUT PRISM TO PHORIAS AT THREE DISTANCES AND THE EFFECTS OF PLUS AND MINUS LENS POWER TO CROSS CYLINDER FINDINGS AT THE AFORE MENTIONED DISTANCES.

A Thesis
Presented to the Faculty of the College
of Optometry Pacific University

In Partial Fulfillment
Of The Requirements For The Degree
Doctor Of Optometry

By; Willard Gibbs
Jim Roberson

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## INTRODUCTION

The purpose of this thesis is to study the cross cylinder findings of the accommodative system when pre-exposed to a stimulus greater and lesser than the plane of regard.

Also to study the reaction of the phoria findings of the binocular system when pre-exposed to a stimulus greater and lesser than the plane of regard.

## EQUIPMENT UTILIZED

1. Phoropter with fifteen degree rotary prisms.
2. Reduced Snellen card and a near Cross Cylinder testing card.
3. Illumination - 20 foot candles.
4. Record sheets.
5. Projector Snellen chart and cross cylinder chart.

## PROCEDURE

### CONVERGENCE

The patient's subjective refractive error, O.E.P. # 7 was placed in the phoropter and a phoria was taken under dissociation by using rotary prisms and having the patient read the 20/20 line of a reduced Snellen chart at 20 feet and telling the examiner when one target appeared directly above the other target.

Two measurements were taken, one coming from B.I. towards B.O. and the second coming from the direction of B.O. to B.I. These findings were recorded as basic phoria.

The patient was then instructed to observe the chart for 30 seconds through 6 prism diopters B.I., all other factors remaining constant, and a phoria was taken by the same method as before. These findings were recorded as Phoria after B.I..

The patient was then instructed to observe the chart for 30 seconds through 9 prism diopters B.O.. These findings were recorded as Phoria after B.O.

This entire procedure was reproduced at 20 inches, and 16 inches. The only difference being that 9 B.O. was used as well as 9 B.I..

ACCOMMODATIVE

A chart of vertical and horizontal lines was projected at 20 feet. The Jackson Cross Cylinder's were moved into place with the minus axis at 90°. A sufficient amount of plus was then moved into the lens wells so that the vertical lines would appear darker. The patient was then instructed to observe the target and the lens power that brought equality of the vertical and horizontal lines was recorded. If equality was not reported the last vertical response before the reversal to horizontal was recorded. If more than one equal response was given the midpoint was recorded. These findings were recorded as basic cross cylinder at 20 feet.

The patient was then instructed to observe the chart through a lens power of +1.00 D. above his # 7 for a period of 30 seconds with instruction to read the smallest line possible. A cross cylinder was then taken in the same manner as previously described. This findings was recorded as cross cylinder at 20 feet after +1.00 D..

The patient was then instructed to observe the chart through a lens power of -1.50 D. below his number 7 for a period of 30 seconds. A cross cylinder was then taken and recorded as cross cylinder at 20 feet after -1.50 D..

These same procedures were carried out at distance's of 26 inches and 16 inches in precisely the same manner as at

20 feet except ⁄1.50 D. above the # 7 was used rather than ⁄1.00D.

A constant illumination of 20 ft. candles was used through out the entire testing period.

On the average, the time used to take the two phoria findings used in this experiment was 9 seconds.

SAMPLE RECORDING SHEET

Patient's name ----------

Patient's age ----------

Patient's # 7 ----------

Basic far phoria. 1. ___ 2. ___ 3. ___ 4. ___ 5. ___

Far phoria after 6 B.I. 1. ___ 2. ___ 3. ___ 4. ___ 5. ___

Far phoria after 9 B.O. 1. ___ 2. ___ 3. ___ 4. ___ 5. ___

Basic far c.c. ----------

Far c.c. after +1.00----------

Far c.c. after -1.50----------

Basic 26" phoria. 1. ___ 2. ___ 3. ___ 4. ___ 5. ___

26" phoria after 9 B.I. 1. ___ 2. ___ 3. ___ 4. ___ 5. ___

26" phoria after 9 B.O. 1. ___ 2. ___ 3. ___ 4. ___ 5. ___

Basic 26" c.c. ----------

26" c.c. after +1.50----------

26" c.c. after -1.50----------

Basic 16" phoria 1. ___ 2. ___ 3. ___ 4. ___ 5. ___

16" phoria after 9 B.I. 1. ___ 2. ___ 3. ___ 4. ___ 5. ___

16" phoria after 9 B.O. 1. ___ 2. ___ 3. ___ 4. ___ 5. ___

Basic 16" c.c. ----------

16" c.c. after +1.50----------

16" c.c. after -1.50----------

## CALCULATIONS

The phoria findings through B.I. and B.O. were averaged and compared to the average habitual phoria on each individual. They were recorded as plus difference if they showed an increase in exo above the basic or a decrease in eso from the basic phoria. They were recorded as minus differences if they showed a lesser amount of exo than the basic or a greater amount of eso than the basic phoria.

The same thing was done to the cross cylinder findings. If the cross cylinder findings after plus or minus showed more plus or less minus it was recorded as a plus difference, and if it showed less plus or more minus it was recorded as a minus difference.

The arithmetic mean for each group of findings and differences was then calculated. In addition at the 16 inch distance the standard deviation was calculated for each group of findings and differences.

## CALCULATED ARITHMETIC MEAN

### Cross Cylinders

| 20 ft. | 26" | 16" | S.D. (16") |
|---|---|---|---|
| Basic c.c.---- ±0.125 D. | ±0.550 D. | ±1.0185 D. | 1.620 |
| After plus---- ±0.0875 D. | ±0.2875 D. | ±0.2125 D. | .230 |
| After minus--- -0.4875D. | -0.5125 D. | -0.6500 D. | .375 |

### Phoria

| 20 ft. | 26" | 16" | S.D. (16") |
|---|---|---|---|
| Basic phoria-- 0.325$^{\Delta}$ xo. | 2.375$^{\Delta}$ xo | 4.350$^{\Delta}$ xo | 4.716 |
| After B.I.---- ±1.875 | ±2.875 | ±2.175 | 2.047 |
| After B.O.---- -2.475 | -1.200 | -2.050 | 1.589 |

| | Basic Phovia | After B.I. | After B.O. | 26" Phovia | After B.I | After B.O. | 16" Phovia | After B.I. | After B.O. |
|---|---|---|---|---|---|---|---|---|---|
| N | | | | | | | | | |
| 1. | 4½ xo | +1 | -2½ | 13 xo | 0 | -1 | 13 xo | +3½ | 0 |
| 2. | 1 eso | +1 | -6 | ½ xo | +2 | -3 | 2 xo | +3 | -2½ |
| 3. | 2½ xo | +1½ | -½ | 4½ xo | +2½ | +1 | 9½ xo | 0 | -2 |
| 4. | 2 eso | +1 | -3 | 1½ xo | +2 | -½ | 3 xo | +3 | 0 |
| 5. | ½ eso | +3 | -4½ | 4½ xo | +1½ | -6 | 3½ xo | +1½ | -3½ |
| 6. | 1½ xo | +3½ | -½ | 6½ xo | +½ | 0 | 6 xo | +3 | +½ |
| 7. | 2 eso | +½ | -3 | 3 eso | +3 | -1½ | 2½ eso | +3½ | -1½ |
| 8. | 2 eso | -½ | -1½ | 4 xo | +1 | -1 | 11 xo | -4 | -1 |
| 9. | ½ xo | +2 | -2½ | ½ eso | +6½ | +2½ | 5½ xo | +½ | -1½ |
| 10. | 1 xo | +2½ | -2½ | ½ xo | +4 | -1½ | ½ eso | +5 | -2 |
| 11. | 2½ xo | +2 | -1½ | 4½ xo | +1 | -2 | 3½ xo | +3 | -1½ |
| 12. | ~~0~~ | +4 | -2 | 4 xo | +4½ | +½ | 5 xo | 0 | -5 |
| 13. | 1 eso | +1½ | -3 | 9 eso | +7½ | +1 | 4½ eso | +5 | -1½ |
| 14. | 4 eso | -½ | -3 | 2½ eso | +5 | -1½ | 2 eso | +4 | -½ |
| 15. | 2½ xo | +3½ | 0 | 2 xo | +4½ | -½ | 1½ xo | +2½ | -2 |
| 16. | ½ eso | +2 | -3 | ½ xo | +3½ | -1 | 4 xo | +1½ | -2½ |
| 17. | ½ xo | +3 | -4 | 5 xo | +3½ | -2 | 8 xo | +3½ | -5 |
| 18. | 1 xo | +3½ | +½ | 2 xo | +1½ | -½ | 5½ xo | +1½ | -1½ |
| 19. | 4 xo | +1 | -2½ | 6½ xo | +1 | -2 | 11 xo | +1½ | -4 |
| 20 | 1 eso | +2 | -4 | 3 xo | +2½ | -5 | 4½ xo | +2 | -4 |
| | 20½ xo | +37½ | -49½ | 62½ xo | +57½ | -24 | 96½ xo | +113½ | -41 |
| | 14 eso | | | 15 eso | | | 9½ eso | | |
| | 6½ xo | | | 47½ xo | | | 87 xo | | |
| | 6½ / 20 = | 37½ / 20 = | 49½ / 20 = | 47½ / 20 | 57½ / 20 | 24 / 20 | 87 / 20 | 113½ / 20 | 41 / 20 |
| | .325 xo | +1.875 | -2.475 | 2.375 xo | +2.875 | -1.2 | 4.35 xo | +2.175 | -2.05 |

## PHORIA

| | | | |
|---|---|---|---|
| 1. | 4 - 13 | = 9 | = 81 |
| 2. | 4 - 2 | = 2 | = 4 |
| 3. | 4 - 10 | = 6 | = 36 |
| 4. | 4 - 3 | = 1 | = 1 |
| 5. | 4 - 4 | = 0 | = 0 |
| 6. | 4 - 6 | = 2 | = 4 |
| 7. | 4 + 3 | = 7 | = 49 |
| 8. | 4 - 11 | = 7 | = 49 |
| 9. | 4 - 6 | = 2 | = 4 |
| 10. | 4 + 1 | = 5 | = 25 |
| 11. | 4 - 4 | = 0 | = 0 |
| 12. | 4 - 5 | = 1 | = 1 |
| 13. | 4 + 5 | = 9 | = 81 |
| 14. | 4 + 2 | = 6 | = 36 |
| 15. | 4 - 2 | = 2 | = 4 |
| 16. | 4 - 4 | = 0 | = 0 |
| 17. | 4 - 5 | = 1 | = 16 |
| 18. | 4 - 6 | = 2 | = 4 |
| 19. | 4 - 11 | = 7 | = 49 |
| 20. | 4 - 5 | = 1 | = 1 |
| | | | = 445 |

$= 22.25$

$20 \overline{)445}$

$\sqrt{22.25} = 4.716$

## S.D. For 16" Findings

### B.I.

| | | |
|---|---|---|
| 2 - 4 | = 2 | = 4 |
| 2 - 3 | = 1 | = 1 |
| 2 - 0 | = 2 | = 4 |
| 2 - 3 | = 1 | = 1 |
| 2 - 2 | = 0 | = 0 |
| 2 - 3 | = 1 | = 1 |
| 2 - 4 | = 2 | = 4 |
| 2 + 4 | = 6 | = 36 |
| 2 - 1 | = 1 | = 1 |
| 2 - 5 | = 3 | = 9 |
| 2 - 3 | = 1 | = 1 |
| 2 - 0 | = 2 | = 4 |
| 2 - 5 | = 3 | = 9 |
| 2 - 4 | = 2 | = 4 |
| 2 - 3 | = 1 | = 1 |
| 2 - 2 | = 0 | = 0 |
| 2 - 4 | = 2 | = 4 |
| 2 - 2 | = 0 | = 0 |
| 2 - 2 | = 0 | = 0 |
| 2 - 2 | = 0 | = 0 |
| | | = 84 |

$4.2$

$20 \overline{)84}$

$\sqrt{4.2} = 2.047$

### B.O.

| | | |
|---|---|---|
| 2 - 0 | = 2 | = 4 |
| 2 - 3 | = 1 | = 1 |
| 2 - 2 | = 0 | = 0 |
| 2 - 4 | = 2 | = 4 |
| 2 + 1 | = 3 | = 9 |
| 2 - 2 | = 0 | = 0 |
| 2 - 1 | = 1 | = 1 |
| 2 - 2 | = 0 | = 0 |
| 2 - 2 | = 0 | = 0 |
| 2 - 2 | = 0 | = 0 |
| 2 - 5 | = 3 | = 9 |
| 2 - 2 | = 0 | = 0 |
| 2 - 1 | = 1 | = 1 |
| 2 - 2 | = 0 | = 0 |
| 2 - 3 | = 1 | = 1 |
| 2 - 5 | = 3 | = 9 |
| 2 - 2 | = 0 | = 0 |
| 2 - 4 | = 2 | = 4 |
| 2 - 4 | = 2 | = 4 |
| | | 51 |

$2.55$

$20 \overline{)51}$

$\sqrt{2.55} = 1.589$

| | Fav c.c. | After +1.00 | After -1.50 | 26" c.c. | After +1.50 | After -1.50 | 16" c.c. | After +1.50 | After -1.50 |
|---|---|---|---|---|---|---|---|---|---|
| 1. | +0.50 | 0 | -.25 | +0.50 | +0.50 | -0.50 | 0 | +.87 | -.12 |
| 2. | -1.00 | 0 | -.25 | +0.25 | 0 | -.50 | +0.75 | 0 | -1.25 |
| 3. | -0.25 | +0.25 | -.75 | -0.25 | +0.50 | 0 | +1.25 | 0 | -0.75 |
| 4. | Pl | 0 | -.25 | +0.75 | +0.25 | -0.50 | +1.62 | -0.12 | -1.62 |
| 5. | +0.50 | +0.25 | -.50 | +1.00 | +0.50 | -0.50 | +1.50 | +0.50 | -0.25 |
| 6. | +1.50 | 0 | -.50 | +1.50 | +0.25 | -0.25 | +2.00 | 0 | -0.50 |
| 7. | +2.00 | 0 | -.50 | +3.25 | +0.25 | -1.25 | +3.50 | 0 | -1.00 |
| 8. | +1.25 (?) | +0.50 | -1.50 | +0.50 | 0 | -0.50 | +0.25 | 0 | -1.00 |
| 9. | +1.00 | -0.25 | -.50 | +1.00 | +0.75 | 0 | +1.75 | +0.50 | 0 |
| 10. | -5.50 | 0 | -.50 | -5.25 | +1.00 | 0 | -4.50 | +0.25 | -0.75 |
| 11. | -1.75 | 0 | -.50 | -1.25 | +0.50 | -0.75 | -0.75 | +0.50 | -0.50 |
| 12. | -0.25 | 0 | -.25 | +0.25 | +0.25 | -1.00 | +0.75 | +0.25 | -0.75 |
| 13. | -0.25 | 0 | -.50 | +0.75 | +0.25 | -0.25 | +1.50 | 0 | -0.75 |
| 14. | Pl | 0 | -.25 | +1.25 | 0 | -1.00 | +1.50 | 0 | -0.50 |
| 15. | +0.50 | 0 | -.25 | +1.25 | +0.25 | -0.75 | +1.50 | +0.50 | -0.25 |
| 16. | Pl. | 0 | -.50 | +0.50 | +0.25 | -0.50 | +1.00 | 0 | -0.50 |
| 17. | +1.75 | 0 | -.75 | +2.25 | +0.25 | -0.50 | +2.75 | +0.25 | -0.75 |
| 18. | -0.25 | +0.25 | -.50 | +0.50 | 0 | -0.25 | +1.50 | 0 | -0.50 |
| 19. | +1.50 | +0.25 | -.50 | +2.00 | 0 | -0.75 | +2.50 | +0.25 | -0.75 |
| 20. | -1.50 | +0.50 | -.25 | -0.25 | 0 | -0.50 | Pl. | +0.50 | -0.50 |
| | -10.75 | | | +17.50 | | | +25.62 | | |
| | +10.50 | | | -6.50 | | | -5.25 | | |
| | -0.25 = | +1.75 = | -8.75 = | 11 = | 5.75 | -10.25 | 20.37 | +4.25 | -13.00 |
| | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| | -.0125 | +.0875 | -.4375 | +.550 | +.2875 | -.5125 | +1.0185 | +.2125 | -.650 |

| C. C. | + Phase | - Phase |
|---|---|---|
| 1. 1 − 0 = 1 = 1.0000 | +.25 −.87 = .62 = .3844 | .12 − .12 = .50 = .2500 |
| 2. 1 − .75 = .25 = .0625 | +.25 − 0 = .25 = .0625 | .62 − .25 = .63 = .3969 |
| 3. 1 − 1.25 = .25 = .0625 | +.25 − 0 = .25 = .0625 | .62 − .75 = .13 = .0169 |
| 4. 1 − 1.62 = .62 = .3844 | +.25 +.12 = .37 = .1369 | .62 − 1.62 = 1 = 1.000 |
| 5. 1 − 1.50 = .50 = .2500 | .25 − .50 = .25 = .0625 | .62 − .25 = .37 = .1369 |
| 6. 1 − 2.00 = 1.00 = 1.0000 | .25 − 0 = .25 = .0625 | .62 − .50 = .12 = .0144 |
| 7. 1 − 3.50 = 2.50 = 6.2500 | .25 − 0 = .25 = .0625 | .62 − 1.00 = .38 = .1444 |
| 8. 1 − .25 = .75 = .5625 | .25 − 0 = .25 = .0625 | .62 − 1.00 = .38 = .1444 |
| 9. 1 − 1.75 = .75 = .5625 | .25 − 0 = .25 = .0625 | .62 − 0 = .62 = .3884 |
| 10. 1 + 4.50 = 5.50 = 30.2500 | .25 − .25 = 0 = .0000 | .62 − .75 = .13 = .0169 |
| 11. 1 + .75 = 1.75 = 3.0625 | −.25 − .50 = .25 = .0625 | .62 − .50 = .12 = .0144 |
| 12. 1 − .75 = .25 = .0625 | .25 − .25 = 0 = .0000 | .62 − .75 = .13 = .0169 |
| 13. 1 − 1.50 = .50 = .2500 | .25 − 0 = .25 = .0625 | .62 − .75 = .13 = .0169 |
| 14. 1 − 1.50 = .50 = .2500 | .25 − 0 = .25 = .0625 | .62 − .50 = .12 = .0144 |
| 15. 1 − 1.50 = .50 = .2500 | .25 − .50 = .25 = .0625 | .62 − .25 = .37 = .1369 |
| 16. 1 − 1 = 0 = .0000 | .25 − 0 = .25 = .0625 | .62 − .50 = .12 = .0144 |
| 17. 1 − 2.75 = 1.75 = 3.0625 | .25 − .25 = 0 = .0000 | .62 − .25 = .13 = .0169 |
| 18. 1 − 1.50 = .50 = .2500 | .25 − 0 = .25 = .0625 | .62 − .50 = .12 = .0144 |
| 19. 1 − 2.50 = 1.50 = 2.2500 | .25 − .25 = 0 = .0000 | .62 − .75 = .13 = .0169 |
| 20. 1 − 0 = 1 = 1.0000 | .25 − .50 = .25 = .0625 | .62 − .50 = .12 = .0144 |
| 50.8219 | 1.3963 | 2.7857 |
| 2.5411 | .0698 | .1393 |
| 20 / 50.8219 | 20 / 1.3963 | 20 / 2.7857 |
| $\sqrt{2.5} = 1.62$ | $\sqrt{.0698} = .23$ | $\sqrt{.1393} = .375$ |

| # 7 | Basic C.C. | Difference | $n^2$ |
|---|---|---|---|
| 1. +1.00 | +0.50 | +0.50 | .2500 |
| 2. -0.25 | -1.00 | 0.75 | .5625 |
| 3. +0.50 | -0.25 | 0.75 | .5625 |
| 4. +0.50 | Plano | 0.50 | .2500 |
| 5. +0.50 | +0.50 | 1.00 | 1.0000 |
| 6. +1.75 | +1.50 | 0.25 | .0625 |
| 7. +2.50 | +2.00 | 0.50 | .2500 |
| 8. +0.50 | +1.25 | 0.75 | .5625 |
| 9. +1.50 | +1.00 | 0.50 | .2500 |
| 10. -5.00 | -5.50 | 0.50 | .2500 |
| 11. -1.00 | -1.75 | 0.75 | .5625 |
| 12. Plano | -0.25 | 0.25 | .0625 |
| 13. Plano | -0.25 | 0.25 | .0625 |
| 14. +0.75 | Plano | 0.75 | .5625 |
| 15. +0.75 | +0.50 | 0.25 | .0625 |
| 16. +0.25 | Plano | 0.25 | .0625 |
| 17. +1.00 | +1.75 | 0.75 | .5625 |
| 18. +0.50 | -0.25 | 0.75 | .5625 |
| 19. +0.50 | +1.50 | 1.00 | 1.0000 |
| 20. -1.25 | -1.50 | 0.25 | .0625 |
| | | | 7.5625 |

$$20 \overline{)\,7.5625} \quad .3781$$

$$\sqrt{.3781} \quad .6148$$

S.D. .6148

## CONCLUSION

1. This study indicates that the resulting change of a phoria after being instructed to observe through Base In prism and Base Out prism is in the magnitude of two prism diopters. That is, B.O. decreases exophoria or increases the esophoria in the general magnitude of two prism diopters, and B.I. increases exophoria or decreases esophoria in the general magnitude of two prism diopters. Which is comparable to a lens power of .37 D.

2. It was expected that there would be little if any change in the cross cylinder findings after the patient had been subjected to plus, because the basic cross cylinder findings was taken by coming down from plus. In reality the only difference in the basic cross cylinder and the cross cylinder after plus is that the patient observed the target for 30 seconds through plus before the cross cylinder was taken and with the basic cross cylinder the patient was subjected to plus only for the length of time that was necessary to determine the equalization point.

This assumption was verified at 20 feet, but at 26 inches and 16 inches there was an increase of plus after instruction ot observe throwgh plus, of a magnitude of .25 D. This leads us to assume that the time factor played a part in the amount of the lens power manifested.

A definite and greater change was found after exposure to minus. A fairly constant change of .50 D. less plus or more minus than the basic was shown at all three testing distances.